Cope (1898) placed his *Bipes biporus* in the monotypic genus *Euchirotes*, distinguishing the two genera (*Bipes* and *Euchirotes*) largely on the basis of the presence of a claw on the fifth digit of *Euchirotes*, the absence in *Bipes*. In two of our specimens, these claws are distinctly present, although small, and thus the character previously considered of generic value is shown to be even specifically variable. *B. biporus*, however, remains distinct from *canaliculatus* on the basis of other characters.

The following table gives general features of scalation and proportion:

VARIATION IN BIPES CANALICULATUS

No.	Ventral annuli on body	Ventral annuli on tail	Dorsal annuli	Pre-anal pores	Snout to vent	Tail	Head to occiput
					Mm	*Mm*	*Mm*
795	154	32+	197	6	158.8	24.0	8.0
966	154	29+	195	6	166.5	26.4	7.5
968	152	30+	194	6	166.5	24.8	8.0
969	149	30+	199	6	167.0	25.4	8.0
799	163	34+	200	6	170.0	27.0	8.0
800	152	32+	198	6	180.0	26.8	8.0
967	153	—	195	6	180.7	—	8.1
798	158	32+	199	6	181.0	28.0	8.0
797	162	—	198	6	185.0	—	8.2
964	156	32	200	6	190.0	29.0	8.0
796	155	—	196	6	192.0	—	8.3
965	164	35+	201	6	192.0	30.1	8.0

Two small frontals; a very large prefrontal; a large rostral; two nasals, somewhat smaller than rostral, nostrils perforating them nearer anterior edge; two large upper and two large lower labials, followed in each case by two smaller labials scarcely or no larger than scales of temporal region; eye in an ocular scale surrounded by a single preocular, two suboculars, and bordered posteriorly by two other small scales, all subequal; a large mental, smaller than rostral, and bordered posteriorly by another scale somewhat smaller, this in turn bordered on each side by a scale somewhat smaller and in contact with lower labials; dorsal annuli separated from ventral annuli very abruptly on a lateral line on each side; dorsal surface of limbs with about 6 annuli; digits 2–4 with 3 dorsal, 4 ventral scales, first digits with 2 dorsal, 3 ventral scales; a short gular fold between and in front of arms; latter 5–6 mm long in our specimens.

Color in life, uniform light brown above, lighter between annuli and between scales forming annuli; head in front of eyes, brownish cream, ventral surfaces pink, lighter to white posteriorly, limbs especially pink.

But little variation obtains in the scutellation of head, quite uniform in all except one in which on each side is a minute scale against the nasal between the second upper labial and preocular, another in which the left supraocular of each side is partially fused with the prefrontal, and another in which the right frontal was broken up into small scales, possibly due to injury.

Xenosaurus rackhami Stuart

A single specimen (no. 111524) of this species, of which only the type from Guatemala has previously been described, was presented me by Sr. Rafael Martín del Campo, of the Instituto de Biología in Mexico City. It was collected by Mario del Toro Áviles at Santa Rosa, near Comitán, Chiapas, during the summer (June to August) of 1937.

It agrees with the description of *rackhami* in the relatively large size of the gular scales, close approximation of the enlarged tubercles on the forearm, and the broad, low character of the tubercles on the body. I count 34 transverse rows of abdominal scales from axilla to groin. The species' most distinctive feature is the large size of the gular scales.

HERPETOLOGY.—*The validity of relative head width in defining the races of* Ambystoma macrodactylum.[1] M. B. Mittleman, New Rochelle, N. Y. (Communicated by Herbert Friedmann.)

In a recent paper (1948) I presented the results of an investigation into certain aspects of the morphological variation of the salamander *Ambystoma macrodactylum*. Although several characters were studied, only three were found to display any variation significantly associated with geographic origin. These important variables are: Vomerine tooth counts, proportion of head width to head length, and proportion of head width to snout-vent length. The variations of these three characters are associated with certain geographic populations of *Ambystoma macrodactylum*, such that when the definitive range of variation for

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each character is calculated for specimens from each of two general geographic areas in the over-all distribution of the species (*sensu lato*), it is possible to identify not less than 71 per cent of more than 300 specimens as to geographic origin, on the basis of any one of these discrete variables. Taken collectively, the three criteria together with certain color and pattern differences, will correctly identify the provenance of at least 85 per cent of the specimens seen in the course of this study.

In view of the highly significant association between these criteria and certain geographic populations, two races of *Ambystoma macrodactylum* were recognized: the typical form, *A. macrodactylum macrodactylum* Baird, occupying the Columbia Plateaus Province and the Northern Basin and Range Province in Washington and Oregon, and extending through the Cascade-Sierra Province from northern California to southern and western British Columbia; also a race, *A. macrodactylum krausei* Peters, occupying the Northern Rocky Mountains Province in Idaho and Montana, southwestern Alberta, eastern and northern British Columbia, and questionably extending east to Iowa.

In studying the relative head widths of the various samples used in this investigation, it was found that the ratio of head width to snout-vent length (hereafter called *HW/SV* ratio) provided a useful index to proportionate head width. However, two major types of variation were at once discernible: ontogenetic and geographic. It was found that when eastern and western specimens of equal snout-vent length were compared, eastern specimens tended usually to have proportionately narrower heads (lower *HW/SV* ratio) than did western specimens (higher *HW/SV* ratio). Despite the fact that this difference in *HW/SV* ratio between strictly comparable specimens provided a useful dichotomous character for discriminating between eastern and western specimens, its use was complicated by virtue of the fact that a prominent intra-population ontogenetic variation in the *HW/SV* ratio was present simultaneously. In brief, it was not possible to distinguish between the eastern and western populations merely by stating that population "X" had an *HW/SV* ratio of so much or more, while population "Y" had an *HW/SV* ratio of so-and-so or less, since the ratio itself changes very drastically as the animal grows and matures beyond the post-metamorphic stage.

The *HW/SV* ratio gradually diminishes from about 20 per cent in young, recently metamorphosed animals, to about 15 per cent in fully mature specimens, thus indicating that the head becomes progressively narrower relative to the snout-vent length as the animal grows in size.

Hence, in order to utilize dichotomously the differential in *HW/SV* ratio which was found in comparable specimens of the eastern and western populations, it was necessary to employ some device which would distinguish between the two populations, regardless of the size of the specimen(s) involved, and thereby circumvent the intrapopulation ontogenetic trend. The simplest solution to the problem was the utilization of a formulary device, based on the independent variable (snout-vent length), which could be applied to any snout-vent length and produce a fixed mathematical value. With such a value available, a dichotomous character results, for it is then possible to say that for any given snout-vent length population "X" has an *HW/SV* ratio (or head width) greater than the computed formulary value, while population "Y" has an *HW/SV* ratio (or head width) less than the formulary value. Such a formula was computed for comparing raw head width measurements, and another, derivative formula was likewise developed for comparing relative head widths (*HW/SV* ratios). These two formulas are respectively:

$$(2 \log SV)^2 - (\log SV)^2 \qquad (1)$$

$$\frac{(2 \log SV)^2 - (\log SV)^2}{SV} \qquad (2)$$

The application of the first formula to any particular snout-vent length results in a mathematical value which may be conveniently visualized as the "standard" head width for that snout-vent length. The application of the second formula to a given snout-vent length produces a value which may be considered the "standard" *HW/SV* ratio for that snout-vent length. In eastern specimens (*A. m. krausei*), the head width and the *HW/SV* ratio are usually less than the value obtained from either of the two formulas, while in western specimens (*A. m. macrodactylum*) the head width and the *HW/SV* ratio tend to be higher than the formulary values. The formulas produce about the same degree of satisfactory separation of the two populations. In my original paper (*op. cit.*) I published a graph based on the first formula used in conjunction with 86 specimens equally divided between the eastern and western populations. That the formula is a satisfactory dichotomous device, and that the two populations have significantly different head widths when strictly comparable specimens are examined, is reflected in the fact that 61 out of the 86 specimens used (= 71 per cent) in preparing the graph are correctly separated by the curve computed from the formula. When this result is tested by chi-square to determine if it could have been fortuitous or resulted from a significant association between head width size and geographic origin, a chi-square value of 17.7 is obtained, indicating a highly significant association between the variable (head width) and geographic origin.

More recently, Joshua L. Baily, Jr., has reviewed my study of *Ambystoma macrodactylum*, with especial attention to the problem of the significance of the differences existing between the head widths of eastern and western specimens. Mr. Baily's paper includes an excellent discussion of some properties of the arithmetic mean, and of another average, the trigonometric mean, but does not appear to contribute in any way to the problem at hand. Baily states in the beginning of his paper (1948, p. 171) that he is inclined to question whether my material adequately demonstrates a real difference in head width in the salamanders under discussion, but in the conclusion of his paper (p. 174) Baily says that confirmation is given to my conclusion that Idaho specimens have narrower heads than do specimens from Oregon and Washington, subject to certain limitations.

Baily has attacked the problem of determining whether a significant head width difference exists between these two populations through the medium of comparing certain means, and the differences between these means. His results show that there exists a significant difference between the means of the *HW/SV* ratios of the two populations, whether the arithmetic mean or the trigonometric mean is used. However, although Baily's results confirm my original contention, his use of means to investigate the problem is open to serious question. When organisms display a strong ontogenetic variation in certain structural characters, as do these salamanders, the comparison of means based on these characters and predicated on random samples seems to me to be essentially meaningless. To have any true biological and statistical significance, such means must properly be based on equal numbers of specimens of each of the two populations or samples, for any given size class. Baily drew his data from the graph published in my original paper (*loc. cit.*), but it will be noted that the 43 Idaho specimens used in preparing this graph range from 41 to 59 mm in snout-vent length, while the 43 Oregon and Washington specimens vary from 40 to 68 mm, with not less than 10 out of the 43 western specimens being 60 mm^{+} in length. As I have pointed out, the tendency in these ambystomids is to develop a proportionately narrower head as the snout-vent length increases. Hence, with 23 per cent of the Oregon-Washington sample of greater length than any available Idaho specimens (of those used in preparing the graph), means of the *HW/SV* ratios of these two samples would be biased toward a relatively lower figure for the western (Oregon-Washington) specimens than that obtained for the eastern (Idaho) specimens, and hence the difference between these means would tend to diminish. That the difference between these means is still significant, as Baily found, is strong confirmation of the real difference in head width in these two populations. Had there been Idaho specimens in the 60–68 mm range, the difference would probably have been even greater, as it would likewise have been if the Oregon-Washington specimens in the 60–80 mm range had been deleted from Baily's computations; with strictly comparable numbers of specimens from each of the two samples available for each size class, the difference would have been still greater. In any event, a far better procedure for the determination of the significance of the difference in head width in these two populations would be to use a test such as the chi-square, or the standard error of the difference between the regression coefficients (of the head width—snout-vent regression of each sample).

In his conclusion, Baily states that my original finding respecting the difference in head width is confirmed "subject to limitations hereinbefore noted." The only possibly pertinent limitation Baily has noted, is that in my original paper I stated that the populations representing the races *krausei* and *macrodactylum* are homogeneous *intra se*, whereas Baily says that despite significant differences in the head widths of the two samples there may be local races of *macrodactylum* which do not differ from the Idaho (*krausei*) population in the same manner as the samples from Oregon and Washington which were used in this study. This is of course a distinct possibility; however, in the course of my investigation numerous intrapopulational comparisons of various criteria were made, and in no instance did the results suggest any other conclusion but that *krausei* and *macrodactylum* are composed of homogeneous populations, as defined in my paper.

In closing his paper, Baily points out what appears to be a *lapsus* on my part, in that the formula used in my graph is amenable to simplification, and can be reduced to—

$$\frac{6 \log (SV)}{SV}$$

However, this is the formula for a ratio, whereas the formula used in my graph is that of a simple equation. Baily goes on to state that my formula produces a "standard" head width—which is correct so far as the formula used for the graph is concerned. But obviously, in presenting his apparently simpler formula, he has reference to the second of my two formulas given above, which yields a "standard" HW/SV ratio, not a "standard" head width. In any event, Baily's formula produces an arithmetic result completely incompatible with either of my formulas, and the value obtained has no pertinency in the present problem.

Despite Baily's contentions to the contrary, the apparently straight line in my graph is a portion of a curve, and this curve passes through the common origin of both the HW and SV scales, if the graph is expanded so that both the abscissa and ordinate scales start at zero values. This curve is not asymptotic, as Baily maintains, since a zero value of SV will produce a zero formulary value, thus causing the curve to pass through the common origin of both scales of the graph.

SUMMARY

1. The problem of the dichotomous utilization of an ontogenetic variable, specifically the HW/SV ratio in *Ambystoma macrodactylum*, is discussed. The significant difference in the head widths of specimens of comparable snout-vent lengths of *A. m. krausei* and *A. m. macrodactylum* is reaffirmed, as is also the usefulness of the formula $(2 \log SV)^2 - (\log SV)^2$ in defining dichotomously the head widths of specimens of any snout-vent length.

2. Joshua L. Baily's use of various means to analyse the differences in head widths of *A. m. krausei* and *A. m. macrodactylum* is discussed, and the limitations involved in the use of means predicated on ontogenetically-variable ratios are pointed out.

3. Baily's contention of a *lapsus* in my original paper is refuted, his confusion of two formulas is pointed out, and it is noted that my curve is non-asymptotic, and that the formula from which it is derived is not amenable to further simplification.

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